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Experiments and simulations to understand the impact of engineering features on Inertial Confinement Fusion implosions[1]

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Engineering features play a crucial role in determining the performance of Inertial Confinement Fusion implosions by seeding jets of cold contaminant into the hot spot[1]. Fill tubes are a dominant degradation mechanism in layered implosions on the NIF[2] and the target mount plays an important role in direct drive implosions[3]. Minimizing the impact of capsule joints and fill tubes is also critical for double shell capsules to be a viable path to ignition[4]. Nevertheless, much of our understanding of features comes from simulation and accurate prediction of their effects requires expensive 3D simulations[1,5]. We have applied the hydrogrowth radiography (HGR) platform[6] to understand the impact of the joint in double shell implosions and are designing experiments to evaluate the fill tube impact. Mitigation strategies[4] are predicted to nearly eliminate the impact of both features on double shell implosions. HGR experiments are used to reduce modeling uncertainties and validate simulations of features using xRAGE[7,8], an Eulerian radiation-hydrodynamics code, and play a key role in ensuring the viability of mitigation strategies. xRAGE is ideal for modeling the impacts of features due to its ability to easily and accurately model features with high resolution in routine simulations with adaptive mesh refinement. We will discuss our mitigation strategies, HGR experimental results, and efforts to improve and validate our modeling capabilities. [1]Haines et al., Nature Comm. 11:544, 2020. [2]Pak et al., Phys. Rev. Lett. 124:145001, 2020. [3]Gatu Johnson et al., Phys. Plasmas 27:032704, 2020. [4]Haines et al., Phys. Plasmas 26:102705, 2019. [5]Haines et al., Phys. Plasmas 26:012707, 2019. [6]Smalyuk et al., Phys. Rev. Lett. 112:185003, 2014. [7]Gittings et al., Comput. Sci. Discov. 1:015005 2008. [8]Haines et al., Phys. Plasmas 24:052701, 2017.

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